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EROS' RAHE DORSUM PLANE: IMPLICATIONS FOR INTERNAL STRUCTURE AND PARTIAL DIFFERENTIATION

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An intriguing discovery of the NEAR imaging and laser-ranging experiments was the ridge system known as Rahe Dorsum and its possible relationship with global-scale internal structure. The curved path of the ridge over the surface roughly defines a plane cutting through Eros. Another lineament on the other side of Eros, Calisto Fossae, seems to lie nearly on the same plane. The NEAR teams (e.g., [1, 2]) interpret Rahe as the expression of a compressive fault (a plane of weakness), because portions of it form a scarp, which on Earth would be indicative of horizontal compression, where shear displacement along a dipping fault has thrust the portion of the lithosphere on one side of the fault up relative to the other side. However, given the different geometry of Eros, a scarp may not have the same relationship to underlying structure as it does on Earth. The plane through Eros runs nearly parallel to, and just below, the surface facet adjacent to Rahe Dorsum. The plane then continues lengthwise through the elongated body, a surprising geometry for a plane of weakness on a battered body. Moreover, an assessment of the topography of Rahe Dorsum indicates that it is not consistent with displacement on the Rahe plane. Rather, the topography suggests that Rahe Dorsum results from resistance of the Rahe plane to impact erosion. Such a plane of strength might have formed in Eros' parent body by a fluid intrusion (e.g., a dike of partial melt) through undifferentiated material, creating a vein of stronger rock. Albedo, color, and near-infrared spectra suggest a distinct material composition consistent with such a history. However the plane of strength formed, it would have interesting implications for the thermal history of the body. Moreover, such structural reinforcing might have enabled and controlled the elongated irregular shape of Eros, as well as Rahe Dorsum.

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SEARCH FOR EXTINCT ^{36}Cl IN Ca-Al-RICH INCLUSIONS IN PRIMITIVE ORDINARY CHONDRITES

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Introduction: The short-lived radionuclide ^{36}Cl decays to either ^{36}Ar (98.1%, β^-) or ^{36}S (1.9%, ε and β^+), with a half life of 3.01×10^5 yr [1]. Recent study has shown that ^{36}S anomalies from the decay of ^{36}Cl exist in sodalite ($Na_8Al_6Si_6O_{24}Cl_2$) of some Ningqiang CAIs and Allende CAIs and chondrule [2–5], but not in sodalite in other CAIs from Allende or Vigarano [6, 7]. In this study, we have expanded the search for ^{36}S anomalies in primitive ordinary chondrites.

Samples and Experimental: The samples used in this study are LEW 88121 (H3) and Y-792947 (H3). Sulfur isotopes (^{33}S, ^{34}S, and ^{36}S) and ^{37}Cl of sodalite grains in CAIs from these two meteorites were measured with the Cameca NanoSIMS 50L ion microprobe at Caltech. A primary Cs^+ beam of 20–30 pA was used to raster areas of 2–3 μm on the sample surface. Negative ions of the selected masses were simultaneously detected with electron multipliers of the multicollection system. Background was monitored periodically at 15 mil-masses from the ^{36}S peak during measurements. Terrestrial sodalite, Canyon Diablo troilite, and troilite texturally close to the analyzed CAIs were used as standards. Terrestrial hauyne ($Na_4Ca_{1.6}K_{0.1}Al_6Si_6O_{30}S_{1.8}Cl_{0.07}$) was measured to determine the Cl/S relative sensitivity factor.

Results and Discussion: The Cl/S ratios in most CAI sodalite grains examined so far in these two H3 chondrites are too low to detect ^{36}S anomalies from the decay of ^{36}Cl. Only one CAI from LEW 88121 contains sodalite that yields resolvable ^{36}S excesses that correlate with Cl/S ratios. The inferred initial ^{36}Cl/^{35}Cl ratio from the regression line is $(1.0 \pm 0.8) \times 10^{-7}$, which is significantly lower than the previously reported initial ^{36}Cl/^{35}Cl ratios (~$1–5 \times 10^{-6}$) in sodalite from Ningqiang or Allende CAIs [2–5]. The high initial ratios of ^{36}Cl/^{35}Cl in sodalite from Ningqiang or Allende CAIs indicate a spallation origin of ^{36}Cl [3]. The substantially lower initial ^{36}Cl/^{35}Cl ratio we observed in ordinary chondrites sodalite implies that either a) the ^{36}Cl production in the early solar system was highly localized, b) the ^{36}Cl-^{36}S systematics were disturbed by later alteration and metamorphism, or c) ^{36}Cl had decayed before the formation of the sodalite in ordinary chondrites.

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